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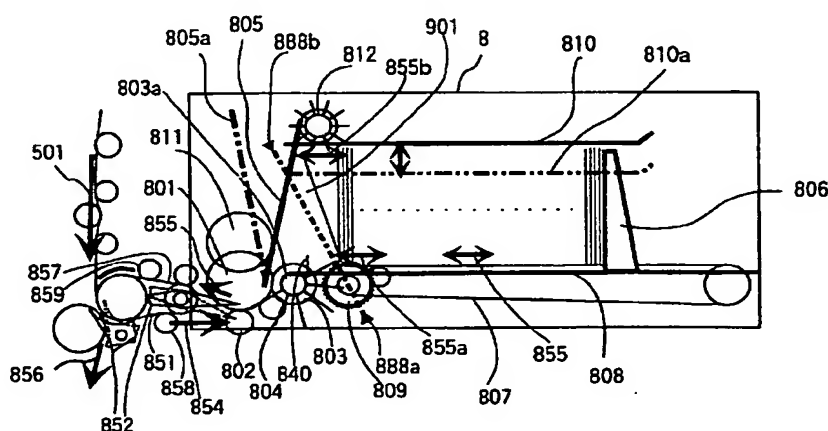
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### (54) Bank note deposit/withdrawal machine

(57) A bank note storage/supply box (8) includes a stack feed roller 801 driven for rotation, a pick-up roller 811, a gate roller 803 not rotating in a carrying-over direction, a brush roller 804 on the same axis as the gate roller 803 with its elastic material radially

arranged, a separation/stack guide 805 movable in a separating operation and a stacking operation, an upper and lower bank note support unit, and a holding plate driven in the horizontal direction.

FIG. 1



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## Description

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to a bank note deposit/withdrawal machine (for example, an ATM used in banking facilities) with which a user can directly deposit and withdraw cash using a card, a bankbook, etc., and more specifically to a bank note storage/supply box used in a circulation type bank note deposit/withdrawal machine using deposited bank notes as bank notes to be withdrawn.

[0002] Conventionally, for example, a bank note deposit/withdrawal machine in a circulation type ATM used in, for example, banking facilities, etc. normally has a bank note storage/supply box with a longitudinally-extended note stack for use in storing deposited banknotes; supplying bank notes to be withdrawn, automatically collecting bank notes, automatically setting bank notes in a device, automatically and carefully counting cash stored in a device, etc.

[0003] On the other hand, there has been proposed a system developed for stacking a plurality of bank note storage/supply boxes having a latitudinally-extended note stack because the system has the merit that the entire system can be designed as a relatively simple feeding system equipped with a number of bank note storage/supply boxes without requiring a larger installation area.

[0004] For example, according to the example of the JP-A-10-188074, a bank note deposit/withdrawal machine contains a bank note storage/supply box with a latitudinally-extended note stack which is not larger in depth even when an additional bank note storage unit is attached.

[0005] With an increasing number of ATMs, etc. bank note deposit/withdrawal machines maintain the conventional functions and performance, and are requested to be smaller, cheaper, and easier in operations. On the other hand, bank notes to be handled are not limited to those in Japanese Yen, but come from various nations. As a result, bank note deposit/withdrawal machines are required to handle various foreign bank notes.

[0006] When foreign bank notes are handled, the following points have to be carefully considered. That is, the number of types of bank notes to be handled becomes much larger than when only Japanese bank notes are handled, and the sizes of foreign bank notes are quite different both in length and width. Additionally, the conditions of folded or broken bank notes can be much worse than Japanese bank notes in consideration of the foreign bank note circulation situation. Therefore, it must be very important to reduce jams of notes, and guarantee the reliability in storing and supplying bank notes.

[0007] As described above, in the above described conventional technology, the reliability of a device,

especially the reliability of the operations when foreign bank notes, which are normally in much worse conditions than Japanese bank notes, are continuously handled and stored in the device has not been carefully considered.

[0008] Therefore, a bank note deposit/withdrawal machine capable of handling foreign bank notes as well as Japanese bank notes, especially a circulation type bank note deposit/withdrawal machine capable of supplying bank notes after receiving deposited bank notes and storing them for withdrawal, should satisfy the following conditions: (1) to have a small and simple configuration; (2) to be highly reliable with the reduced number of bank note jams on a bank notes feeding path; and (3) to have a large capacity for stable and continuous bank notes storage and for continuously separating operations.

### SUMMARY OF THE INVENTION

[0009] The present invention aims at providing a bank note deposit/withdrawal machine capable of functioning as a circulation type bank note deposit/withdrawal machine for continuously handling a large number of foreign bank notes in worse conditions than Japanese bank notes, and capable of stably storing and supplying small bank notes which are often difficult in neatly stacking bank notes.

[0010] To attain the above described object, a bank note deposit/withdrawal machine includes a deposit/withdrawal opening for receiving or supplying bank notes, a bank note discrimination unit for discriminating bank notes, a temporary storage box for temporarily storing bank notes received through the deposit/withdrawal opening, a bank note storage/supply box for storing deposited notes and supplying the notes for withdrawal, and a bank note feeding path for connecting the deposit/withdrawal opening, the bank note discrimination unit, the temporary storage box, and the bank note storage/supply box. In the bank note deposit/withdrawal machine, the bank note storage/supply box includes a stack and separation mechanism, connected to the bank note feeding path, for storing bank notes in the bank note storage/supply box or separating bank notes from the bank note storage/supply box; an upper and lower bank note support unit for rotating in a bank note stacking direction or in the counter-stacking direction to support the bank notes, holding the upper and lower portions of the bank notes, and setting them upright; and a holding plate, horizontally driven in the box with the bank notes held upright. The upper and lower bank note support unit is driven in the same direction as the holding plate. It is desired that the bank note feeding speed is set to be higher than the moving speed of the holding plate.

[0011] In addition, it is desired that the bank note storage/supply box in the bank note deposit/withdrawal machine according to the present invention further

includes a bank note guide which moves to the position at which bank notes can be led to the stack and separation mechanism when the bank notes are separated, and which is incorporated into the upper and lower bank note support unit at the top when the bank notes are stacked.

[0012] It is also desired that the bank note storage/supply box in the bank note deposit/withdrawal machine includes a brush roller for feeding, by a radiantly extended flexible unit, the bank notes received from the stack and separation mechanism to the space in which the bank notes should be stored.

[0013] Furthermore, it is desired that the bank note storage/supply box in the bank note deposit/withdrawal machine includes a bank note support unit for supporting the lower end of the stored bank notes; and a bank note detection sensor, provided in the vicinity of the intersection between the enclosing brush roller and the end of the bank note support unit, for detecting the existence/non-existence of the bank notes above the brush roller for a predetermined time. In addition, it is desired that the holding plate is moved toward the stack and separation mechanism when the bank note detection sensor detects bank notes continuously above the brush roller.

[0014] Additionally, it is desired that the bank note storage/supply box in the bank note deposit/withdrawal machine according to the present invention includes a detector for detecting the thickness or the tilt of the bank notes stacked upright and horizontally, and the bank note deposit/withdrawal machine includes a controller for temporarily stops the operation of storing the bank notes in the bank note storage/supply box when the detector detects a predetermined thickness or a predetermined tilt, and controlling the operation of storing the bank notes in the bank note storage/supply box to be resumed after the holding plate of the bank note storage/supply box has been driven in the counter-stacking direction.

[0015] Furthermore, it is desired that the controller is designed such that, when bank notes are transferred from a bank note storage/supply box to another bank note storage/supply box, the amount of movement of the holding plate of one bank note storage/supply box is compared with the amount of the movement of the plate of the other bank note storage/supply box so that the tilt of the bank notes stored in the other bank note storage/supply box can be discriminated. When the tilt is discriminated, the operation of storing the bank notes in the other bank note storage/supply box is temporarily stopped, the holding plate is driven in the counter-stacking direction to adjust the tilt of the bank notes, and then the storing operation is resumed. At this time, it is furthermore desired that the amount Y of the movement of the holding plate in the storing operation of the bank note storage/supply box and the amount X of the movement of the holding plate from which the bank notes are supplied to the bank note storage/supply box are

detected for comparison.

[0016] It is also desired that the brush roller includes a boss exposure portion on which the radiantly arranged flexible units are not provided at a part so that the brush roller can rotate in the bank note stacking direction when the bank notes are stacked in the storage space, and can stop at a predetermined position when the bank notes stored in the storage space are to be separated.

[0017] Furthermore, it is desired that the bank note storage/supply box of the bank note deposit/withdrawal machine according to the present invention includes a stack deformation unit for forcibly deforming the stacked bank notes.

[0018] Additionally, it is desired that the bank note storage/supply box of the bank note deposit/withdrawal machine according to the present invention includes a controller for controlling the rotation of the brush roller such that the predetermined positional relationship can be maintained between the front end of the stacked bank notes and the flexible units when the bank notes are stacked.

[0019] Then, it is desired that the bank note storage/supply box of the bank note deposit/withdrawal machine according to the present invention includes a top plate for adjusting the position of the storage space depending on the size of bank notes to be stored.

[0020] In addition, it is desired that the bank note storage/supply box of the bank note deposit/withdrawal machine according to the present invention includes side plates for adjusting the position of the storage space depending on the size of bank notes to be stored.

[0021] It is also desired that the bank note storage/supply box of the bank note deposit/withdrawal machine includes a flexible partitioning unit in the storage space in the vicinity of the storage/supply opening.

[0022] In addition, the present invention can be realized by a bank note deposit/withdrawal machine including, as a configuration element, a bank note deposit/withdrawal mechanism having a control unit for controlling a bank note storage/supply box provided with the above described features.

[0023] Still further advantages of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred and alternate embodiments.

#### Brief Description of the Drawings

[0024] The invention will be described in conjunction with certain drawings which are for the purpose of illustration the preferred and alternate embodiments of the invention only, and not for the purposes of limiting the same, and wherein:

Fig. 1 is a side view of the bank note deposit/withdrawal mechanism according to the present inven-

tion;

Fig. 2 is a perspective view of the stack and separation unit of the bank note storage/supply mechanism;

Fig. 3 is a side view of the stack and separation unit of the bank note storage/supply mechanism in a storing operation;

Fig. 4 is a side view of the stack and separation unit of the bank note storage/supply mechanism in a separating operation;

Fig. 5 is a perspective view of the bank note storage/supply mechanism during the storing operation;

Fig. 6 is a perspective view of the bank note storage/supply mechanism in the storing operation completion state;

Fig. 7 is a perspective view of the bank note storage/supply mechanism for explanation of the defective arrangement of bank notes in the longitudinal direction, and the countermeasure;

Fig. 8 is a side view of the bank note storage/supply mechanism for explanation of the defect of the excess thickness of a bank note stack;

Fig. 9 is a side view of the bank note storage/supply mechanism for explanation of the amendment of the excess thickness of a bank note stack;

Fig. 10 is a side view of the bank note storage/supply mechanism for explanation of the storing operation mode after the amendment to the thickness of a bank note stack;

Fig. 11 is a schematic perspective view of the automatic teller machine provided with a bank note deposit/withdrawal mechanism;

Fig. 12 is a block diagram showing the control of the automatic teller machine;

Fig. 13 is a side view of an embodiment of the bank note deposit/withdrawal mechanism according to the present invention;

Fig. 14 is a block diagram showing the control of the bank note deposit/withdrawal mechanism; and

Fig. 15 is a side view of the bank note storage/supply mechanism with a longitudinally-extended note stack.

#### DETAILED DESCRIPTION OF THE PREFERRED AND ALTERNATE EMBODIMENTS

[0025] An embodiment of the present invention is described in detail with reference to the attached drawings.

[0026] Fig. 11 is a perspective view showing the appearance of an automatic teller machine according to the present invention.

[0027] A card/slip processing mechanism 102 for interlocking a card slot 102a provided in a front top panel 101b in the case 101, processing a user card, and printing and issuing a transaction slip, and a bank book processing mechanism 103 for interlocking a bank book

slot 103a and processing a user bank book are in the upper portion of a case 101 of the body of the machine.

[0028] The bank note deposit/withdrawal machine 1 for handling bank notes is provided in the lower portion of the case 101 of the body of the machine. A customer-manipulated unit 105 for displaying and inputting the contents of a transaction is provided in the middle portion of the case 101 of the body of the machine. The numeral 106 denotes a body control unit for generally controlling the automatic teller machine.

[0029] Fig. 12 is a block diagram showing the control of the machine. As described above, the card/slip processing mechanism 102, the bank book processing mechanism 103, the bank note deposit/withdrawal machine 1, and the customer-manipulated unit 105 contained in the case 101 are connected to the body control unit 106 through a bus 106a and performs necessary operations under control of the body control unit 106. In addition to the above described unit, the body control unit 106 is also connected to an interface unit 106b, an operator-manipulated unit 106c, and an external storage device 106d through the bus 106a to transmit and receive necessary data. However, since they are not directly associated with the feature of the present invention, detailed explanation about them is omitted here. A power supply unit 101d shown in Fig. 12 supplies power for each unit and mechanism in the above described configuration.

[0030] Fig. 13 is a side view of the configuration of a bank note deposit/withdrawal machine 1 using the bank note storage/supply box of the present invention in the automatic teller machine shown in Fig. 11.

[0031] The bank note deposit/withdrawal machine 1 includes: a deposit/withdrawal opening 2 for a user depositing and withdrawing bank notes; a bank note discrimination unit 3 for discriminating bank notes; a temporary storage box 4 for temporarily storing deposited bank notes until a transaction is fixed; a deposit box 6 for storing the bank notes for which the transaction has been fixed as deposit; a supply box 7 for storing bank notes for withdrawal; a bank note storage/supply box 8 for both deposit and withdrawal; a rejection box 9 for storing deposited bank notes not stored in the supply box, or bank notes not for withdrawal, that is, bank notes carried over from the supply box (namely, a box for storing bank notes not discriminated by the discrimination unit); a reception and collection box 11 for storing bank notes to fill the bank note storage/supply box 8 and bank notes collected from each box; a bank note feeding path 5 for transmitting bank notes to the deposit/withdrawal opening 2, the temporary storage box 4, the deposit box 6, the supply box 7, the bank note storage/supply box 8, the rejection box 9, and the reception and collection box 11 through the bank note discrimination unit 3; and a control unit 10. The control unit 10 controls the bank note deposit/withdrawal machine 1 according to an instruction from the body control unit 106 and the detection of the state of the bank note

deposit/withdrawal machine 1, and transmits the state of the bank note deposit/withdrawal machine 1 to the body control unit 106 as necessary.

**[0032]** In addition, the bank note feeding path 5 includes: a circular main bank note feeding path 501 having main bank note feeding paths 501a through 501k (indicated by an arrow of solid lines as shown in Fig. 13) for passing sequentially through the bank note discrimination unit 3, the branch point to the deposit/withdrawal opening 2, the joint/branch point of the rejection box 9, the deposit box 6, the supply box 7, the bank note storage/supply box 8, and the reception and collection box 11, and the branch/joint point of the temporary storage box 4, and returning to the bank note discrimination unit 3; and unit feeding paths 251a, 251b, 851a through 851e, 857a through 857e, and 451 for connecting the main bank note feeding path 501 with each unit. On the rejection box 9, a U turn bank note feeding path 860 forming part of the main bank note feeding path 501 is provided.

**[0033]** The deposit unit feeding path 251a joins and feeds bank notes carried over from the deposit/withdrawal opening 2 to the main bank note feeding path 501. The withdrawal unit feeding path 251b branches and feeds bank notes from the main bank note feeding path 501 to the deposit/withdrawal opening 2. The cassette unit feeding paths 851a through 851e for branch and feed bank notes from the main bank note feeding path 501 to each cassette of the rejection box 9, the deposit box 6, the bank note storage/supply box 8, and the reception and collection box 11. The cassette unit feeding paths 857a through 857e join and feed bank notes carried over from the supply box 7, the bank note storage/supply box 8, and the reception and collection box 11 to the main bank note feeding path 501. The temporary storage unit feeding path 451 branches and feeds bank notes from the main bank note feeding path 501 to the temporary storage box 4, and joins and feeds bank notes carried over from the temporary storage box 4 to the main bank note feeding path 501. Furthermore, switching gates 252, 852a through 852e, and 452 are provided at the branch point from the main bank note feeding path 501 to the unit feeding paths 251a, 251b, 851a through 851e, 857a through 857e, and 451, and the control unit 10 controls the feeding of bank notes based on the discrimination result from the bank note discrimination unit 3.

**[0034]** The control unit 10 is connected to the body control unit 106 of the machine through the bus 106a as shown in Fig. 14, controls the bank note deposit/withdrawal machine 1 according to an instruction from the body control unit 106 and a detected state of the bank note deposit/withdrawal machine 1, and transmits the state of the bank note deposit/withdrawal machine 1 to the body control unit 106 as necessary. In the bank note deposit/withdrawal machine 1, the drive motor, the electromagnetic solenoid, and the sensor of each unit (the deposit/withdrawal opening 2, the bank note discrimina-

tion unit 3, the temporary storage box 4, the bank note feeding path 5, the deposit box 6, the supply box 7, the bank note storage/supply box 8, the rejection box 9, and the reception and collection box 11) are connected to the control unit 10, and the control unit 10 monitors transactions through the states of the sensors for each transaction, and controls the driving operation of an actuator.

**[0035]** The storage unit of each unit (the deposit/withdrawal opening 2, the deposit box 6, the supply box 7, the bank note storage/supply box 8, the rejection box 9, and the reception and collection box 11) should be designed to be at least about 100 mm in width and 200 mm in length to handle various foreign bank notes as well as Japanese bank notes. The width of the feeding unit (the bank note discrimination unit 3, the temporary storage box 4, and the bank note feeding path 5) should be at least about 220 mm. Assuming that the minimum bank note in the bank notes to be handle is about 60 mm in width and about 120 mm in length, it is desired that the storage unit of the deposit box 6, the supply box 7, etc. into which an operator and a user set bank notes comprises an adjustable regulator guide (not shown in the attached drawings) to regulate the arrangement of bank notes both in longitudinal and latitudinal directions depending on the size of bank notes to be handled.

**[0036]** The bank note deposit/withdrawal machine 1 has the configuration of each of the above described units 2 through 11 as shown in Fig. 11. The bank note feeding path 5 fixes each of the deposit transaction, the withdrawal transaction, etc. by connecting the units through the unit feeding paths 251a, 251b, 851a through 851e, 857a through 857e, and 451 as described above.

**[0037]** Briefly described below is the operation of the bank note deposit/withdrawal machine 1.

**[0038]** When a deposit transaction is to be fixed, bank notes deposited through the deposit/withdrawal opening 2 are separated sheet by sheet, and join the main bank note feeding path 501 through the deposit/withdrawal unit feeding path 251a. The bank note discrimination unit 3 discriminates the type and the truth/false of banknotes. Then, the bank notes are fed in the main bank note feeding path from 501b to 501h, and are temporarily stored in the temporary storage box 4. The bank notes not discriminated by the bank note discrimination unit 3 or the deposit rejected bank notes whose tilt or intervals are abnormal among the stored bank notes are transmitted from the bank note discrimination unit 3 after switching the switching gate 252, branched toward the deposit/withdrawal opening 2, put into the deposit/withdrawal opening, and returned to the user. The bank notes are not stored in the temporary storage box 4.

**[0039]** If the deposit transaction has been fixed, bank notes are transmitted from the temporary storage box 4 to the main bank note feeding path 501 in the

reverse order of a storing operation, that is, to 501j and 501k. The bank note discrimination unit 3 determines the type and the truth/false of bank notes, and any of the switching gates 852b, 852d, and 852a of the cassette unit feeding paths 851b, 851d, and 851a is switched to store the bank notes in any of the deposit box 6, the bank note storage/supply box 8, and the rejection box 9.

[0040] When a withdrawal transaction is to be fixed, the predetermined number of bank notes are carried over from each of the supply box 7, and the bank note storage/supply box 8. The bank note discrimination unit 3 discriminates bank notes through the main bank note feeding path 501 from 501f to 501k, the switching gate 252 branches the feeding to put the bank notes in the deposit/withdrawal opening 2, and the bank notes are supplied to the user. When the withdrawal is rejected, the bank notes are stored in the rejection box 9, and the supplemental bank notes are added and carried over.

[0041] The configuration and the operations of the bank note storage/supply box 8 according to the present invention, which is applied to the bank note deposit/withdrawal machine 1, are described below in detail with reference to Figs. 1 through 10.

[0042] A plurality of the bank note storage/supply boxes 8 can be installed on the bank note deposit/withdrawal machine 1. According to an embodiment of the present invention, one bank note storage/supply box 8 is installed. Fig. 1 shows the configuration of the bank note storage/supply box 8.

[0043] The bank note storage/supply box 8 is a cash box for storage and separation for carrying over, and comprises to form a storage/supply opening: a stack feed roller 801 rotated and driven by a driving source other than the cash box not shown in the attached drawings through a gear; a pick-up roller 811; a backup roller 802 rotated in an interlocking manner; a stack and separation mechanism comprising a gate roller 803 not rotated in a storing direction, not in a carrying-over direction; a brush roller 804 which is on the same axis as the gate roller 803 and has radially arranged flexible holding units; and a separation/stack guide 805 (bank notes guide) operating when a separating operation and a stacking operation are performed.

[0044] Bank notes are stored in a storage space encompassed by a bottom plate 808, a holding plate 806, a bottom plane belt 807 suspended to support the bottom of the bank notes at a point higher than the bottom plate 808, and the separation/stack guide 805.

[0045] The bank notes stored in the bank note storage/supply box 8 are branched from the main bank note feeding path (indicated by an arrow 501) as indicated by an arrow 854 by switching the switching gate 852 as shown by 852a, and fed between the rotating stack feed roller 801 and the backup roller 802, and between the stack feed roller 801 and the gate roller 803 rotating in the stacking direction. The bank notes fed between the stack feed roller 801 and the gate roller 803 are stored along the separation/stack guide 805, and stored in an

approximately triangular stack space 901 shown in bank note deposit/withdrawal machine 1. The brush roller 804 rotating below the stored bank notes sweeps them in the stacking direction, thereby preventing the interference between the bank notes and the subsequent bank notes.

[0046] In addition, by supporting the top and bottom of the stored bank notes by the upper bank note support unit 812 arranged to be incorporated into the upper portion of the separation/stack guide 805 near the separation/stack guide 805 at the upper portion of the storage unit, and a lower bank note support unit 809 arranged near the gate roller 803 at the lower part of the storage unit, and by sweeping the bank notes toward the holding plate 806 side, the continuously stores bank notes can be maintained upright. The lower bank note support unit 809 can be formed as a belt as shown in Figs. 3 and 4 as well as formed as a sheet roller having radially arranged sheets, and a pulley having a coarse surface for feeding banknotes. When a belt type unit is adopted, the surface can be designed to be coarse to feed bank notes without fail.

[0047] When a separating operation is performed, the separation/stack guide 805 is moved to the position indicated by a two-points-and-one-dash chain line 805a, and the holding plate 806 and the bottom plane belt 807 simultaneously move in the storage space so that a drive source other than the cash box not shown in the attached drawings can give a predetermined pressure to the pick-up roller 811 to move the bank notes by predetermined pressure. The bank notes pressed by the pick-up roller 811 are fed by the rotating stack feed roller 801, and is fed sheet by sheet in the direction indicated by an arrow 855 while preventing double sheets from being simultaneously fed by the gate roller 803 not rotating in the carrying-over direction by the effect of the one-way clutch. At this time, a switching gate 852 is switched into the position indicated by a solid line, and the bank notes are fed in the direction indicated by the arrow 855 through a unit feeding path 857, and then in the direction indicated by an arrow 856.

[0048] When a storing operation is performed, the separation/stack guide 805 moves to the position indicated by the solid line, and the holding plate 806 and the bottom plane belt 807 simultaneously moves in the storage space by a drive source other than the cash box not shown in the attached drawings. With the increasing number of bank notes to be stored, stored bank notes are moved off the separation/stack guide 805 so that the received bank notes fed in the direction indicated by the arrow 854 and the stored bank notes do not interfere with each other. The increase of the number of stored bank notes is monitored by transmission sensors (remaining bank note detection sensor) 888a and 888b. When a continuous dark (a state in which bank notes shut off the transmission sensor 888 for a predetermined time) for a time equal to or longer than a predetermined time is detected, the above described

movement control is performed. At this time, an upper bank note support unit 812 rotates counterclockwise, and the lower bank note support unit 809 rotates clockwise to support the top and bottom of the stored bank notes, push the bank notes toward the holding plate 806, and set the bank notes upright.

[0049] The bank note storage/supply box 8 further comprises a partitioning unit 840 in the storage space near the storage/supply opening so that the bank notes stored upright cannot conflict with the subsequent bank notes by abnormal folding, thereby maintaining the stored bank notes upright. The partitioning unit 840 is made of a elastic material. When a separating operation is performed, the holding plate 806 or the stored bank notes push down the partitioning unit 840, thereby avoiding interfering the separating operation.

[0050] Fig. 2 is a perspective view showing in detail the stack and separation mechanism, the upper bank note support unit 812, and the lower bank note support unit 809.

[0051] An axis 811a of the pick-up roller 811 is synchronously driven by a drive axis 801a of the stack feed roller 801. A drive axis 803a of the brush roller 804 arranged at a random pitch is inversely driven by the drive axis 801a of the stack feed roller 801 through a one-way clutch for shared use of a drive source. When a separating operation is performed with the stack feed roller 801 rotating clockwise, the brush roller 804 is stopped and maintained at an appropriate phase so that the bank notes separating operation may not be disturbed. On the other hand, when a storing operation is performed with the stack feed roller 801 rotating counterclockwise, the brush roller 804 prevents the interference among continuously stored bank notes by continuously rotating clockwise.

[0052] The brush roller 804 includes a boss exposure portion having no pushing units for a half turn to realize a separating operation described later. The rotation phase of the brush roller 804 is controlled for each bank note so that and the end of the stored bank notes can be pushed in the stacking direction by a brush without fail, and the end of the stored bank notes cannot interfere with any unit while bank notes are fed to the bank note storage/supply box 8. That is, the end of bank notes fed to the bank note storage/supply box 8 is detected by a sensor not shown in the attached drawings. Before the bank notes are held by the stack feed roller 801 and the backup roller 802, the rotation of the brush roller 804 or the stack feed roller 801 is adjusted for matching phases. By performing the above described rotation feeding control, the stack feed roller 801 and the backup roller 802 can hold bank notes at a moment when the brush roller 804 is set at a predetermined position.

[0053] Two upper bank note support units 812 for holding the top and the bottom of a bank notes stack are provided in the longitudinal direction on bank notes. Similarly four lower bank note support units (a center

portion 809a, and end portions 809b) are provided. By a drive source not shown in the attached drawings, the bank notes are driven at a higher speed in the bank note stacking direction or in the counter-stacking direction (separating direction) in an interlocking manner with the holding plate 806 and the bottom plane belt 807. The lower bank note end support unit 809b at both ends similar in shape to the brush roller 804 is omitted in Fig. 2 and Fig. 5 referred to later (refer to Figs. 6 and 7).

[0054] The lower bank note support units 809a and 809b are fixed to a connected axis 807a which supports the pulley from which one end of the bottom plane belt 807 is suspended, and rotate with the connected axis 807a.

[0055] The connected axis 807a rotates when the bottom plane belt 807 is driven together with the holding plate 806, and the moving speed (an arrow 855a) of the element in the tangent direction of the lower bank note support units 809a and 809b is higher than the moving speed (arrow 855) of the bottom plane belt 807 by the ratio of the pulley to the radius. Similarly, the moving speed (arrow 855b) of the upper bank note support unit 812 is higher than the bottom plane belt 807 through the mechanism not shown in the attached drawings.

[0056] In a bank note storing operation, stored bank notes receive compressing force by moving the upper bank note support unit 812 and the lower bank note support unit 809 at a speed 1.2 through 1.3 times as higher as the speed of the bottom plane belt 807, that is, the holding plate 806, thereby realizing a continuous storing operation in a stable upright state. By this compression effect, stacked bank notes can be prevented from being too massive, thereby increasing the storage capacity of bank notes.

[0057] The drive axis 803a of the brush roller 804 driven through a one-way clutch supports at two points the gate roller 803 containing a one-way clutch and a stack deforming unit 890 capable of idly rotating and swinging. The operation effect of the stack deforming unit 890 is described below by referring to Figs. 3 and 4. Fig. 3 shows the state in the storing operation. The stack deforming unit 890 rotates clockwise when bank notes are fed, and stops at the upper dead point which projects to a bank note feeding surface 899 and is not shown in the attached drawings. Bank notes 830 being stored have waveform deformation 830a (refer to Fig. 5 described later) depending on the amount of projection from the bank note feeding surface 899. On the other hand, Fig. 4 shows the state in the separating operation. The drive axis 803a is driven clockwise, and the phase of the brush roller 804 at a random pitch is stopped at the position shown in Fig. 4. At this time, the stack deforming unit 890 rotates counterclockwise to the lower dead point not shown in the attached drawings by the moment from the biased center of gravity, and stops at the position shown in Fig. 4 at a small projection above the bank note feeding surface 899. Therefore, continuously separated bank notes are smoothly sepa-



rated without interference of the brush roller 804 which stops at an appropriate position at a random pitch and the stack deforming unit 890.

[0058] Fig. 5 shows the state of the bank notes 830 being stored. The bank notes 830 has waveform deformation 830a by the stack deforming unit 890, and is introduced to the separation/stack guide 805 in the state in which the apparent rigidity of bank notes has increased. As a result, a stable storing operation can be performed.

[0059] The bottom of the bank notes 830 which have been completely stored is horizontally moved to the right by the continuously rotating brush roller 804, and the bank notes are then stacked as shown in Fig. 6. When the number of stored bank notes increases, and a continuous dark equal to or longer than a predetermined time length (for example, 120 ms) is detected by the transmission sensors 888a and 888b shown in Fig. 1, the above described movement control is performed, and the upper bank note support unit 812 and the lower bank note support unit 809 compress the stored bank notes, thereby continuously storing bank notes in a stable upright state.

[0060] Described below is the neat stack in the longitudinal direction and the storage dimensions of smaller bank notes. The bank note storage/supply box 8 is designed depending on the maximum size to be handled, and a low-cost bank note storage/supply box 8 can be provided when various small bank notes can be handled by the bank note storage/supply box 8. However, as described above, there are a number of foreign bank notes quite different from one another in both longitudinal and latitudinal directions. Therefore, to guarantee a stable continuous storage operation, the bank note storage/supply box 8 should have the mechanism added to it.

[0061] The first mechanism is a stopper 810 (top plate) for regulating the position of the upper end of stored bank notes, that is, the position of the shorter sides. As shown in Fig. 1, the first mechanism can be adjusted in the vertical direction together with the upper bank note support unit 812 depending on the type (dimension of shorter sides), and is adjusted for the position indicated by a two-points-and-one-dash chain line 810a, thereby solving the disorder of shorter sides.

[0062] On the other hand, the width of the feeding path of the entire system in the longitudinal direction naturally depends on the maximum bank note to be handles. Therefore, a small bank note has the strong probability that it is fed in a biased manner to left or right by the difference in length of longer sides. To solve the problem of the biased feeding and store bank notes stably, the dimension of the storage for a longer side of the bank note storage/supply box 8 should depend on the maximum bank note. Therefore, in the bank note storage/supply box 8 to which a small bank note can be handled, the order of bank notes can be regulated in a shorter side direction by the stopper 810, but cannot be

regulated in a longer side direction.

[0063] The bank notes stored in disorder in the longitudinal direction unfortunately affect the separating performance, and probably cause the demerit of generating jammed paper because the operation effect does not work on the end portion of the bank notes biased in the longitudinal direction even if the holding plate 806, the upper bank note support unit 812 interlocking the holding plate 806, and the lower bank note support unit 809a are driven, thereby failing in stably feeding bank notes to the feeding surface.

[0064] The second mechanism added to solve the above described problem is the lower bank note support unit 809b provided on both ends of bank notes in the longitudinal direction. As shown in Fig. 7, even both ends of the bank notes 830b deformed into the shape indicated by the two-points-and-one-dash chain line caused as a result of the bias in the longitudinal direction can be fed without fail to the bank notes feeding surface by the effect of the lower bank note support unit 809b provided at both ends, thereby realizing a stable continuous separating operation.

[0065] In addition, assume the position of the sides of the storage space can be adjusted depending on the longitudinal direction of bank notes. Therefore, the disorder in the longitudinal direction can be adjusted.

[0066] If the thickness or the tilt of a horizontally and continuously stacked bank notes is equal to or larger than a predetermined value in an upright state, the bank notes may fall down, thereby possibly making it difficult to keep a stable stacking operation. Furthermore, folded bank notes in a separating operation may prevent the reliability of the machine from being guaranteed. As a result, according to the present invention, the thickness or the tilt of a horizontally and continuously stacked bank notes in an upright state is detected. If the thickness or the tilt equal to or higher than a predetermined value is detected, the operation of storing bank notes can be temporarily stopped, the holding plate 806 is driven in the counter-stacking direction to amend the tilt of the bank notes and resume the storing operation.

[0067] Described below is the method of detecting the thickness or the tilt of bank notes, and the method of controlling the tilt amendment to the bank notes. As shown in Fig. 13, the bank notes continuously stored in the bank note storage/supply box bank note storage/supply box 8 are either the deposited bank notes separated from the supplying deposit/withdrawal opening 2 or the bank notes received as separated from the supplying reception and collection box 11. The thickness of the bank notes separated from the supplying unit is detected as the movement X of the holding plate of the deposit/withdrawal opening 2 or the reception and collection box 11, and the thickness of the bank notes continuously stored by the bank note storage/supply box 8 is detected as the movement Y of the holding plate 806. The control unit 10 compares the detected values. For example, if  $Y \geq 1.2X$ , then it is determined



that the thickness of the continuously stored bank notes is too large, and the separating operation of the supplying unit and the storing operation of the bank note storage/supply box 8 are temporarily stopped. Fig. 8 shows the state of the excessive thickness of the bank notes when the operations are temporarily stopped. Then, the operation mode is switched into a separating operation mode, and the holding plate 806 is driven forward until the separation pressure is detected, thereby amending the fall or tilt of the stored bank notes. Then, as shown in Fig. 10, the operation mode is switched again into the storing operation mode to resume the separation in the supplying unit and the storing operation of the bank note storage/supply box 8. As a result, the above described problems can be solved, and the reliability of the machine can be guaranteed.

[0068] The above described bank note storage/supply box 8 is a system with a latitudinally-extended note stack stored in an upright state. However, the bank note storage/supply box 8 can be a system with a longitudinally-extended note stack stored as shown in Fig. 15. In this case, the features and the effects of each unit forming the bank note storage/supply box 8a are similar to those of each unit forming the bank note storage/supply box 8. Therefore, the detailed explanation is omitted here.

[0069] Furthermore, the medium used in the mechanism according to the present invention can be paper such as marketable securities, lottery, tickets, checks, card, etc. as well as bank notes.

[0070] As described above, the present invention has the following effects.

[0071] A bank note storage/supply box capable of handling various sizes of bank notes both in longer and shorter sides can be successfully provided.

## Claims

1. A bank note deposit/withdrawal machine comprising a deposit/withdrawal opening (2) for receiving or supplying bank notes, a bank note discrimination unit (3) for discriminating bank notes, a temporary storage box (4) for temporarily storing bank notes received through the deposit/withdrawal opening (2), a bank note storage/supply box (8) for storing deposited notes and supplying the notes for withdrawal, and a bank note feeding path (5) for connecting the deposit/withdrawal opening (2) the bank note discrimination unit (3), the temporary storage box (4), and the bank note storage/supply box (8), wherein said bank note storage/supply box (8) includes a stack and separation mechanism, connected to the bank note feeding path (5), for storing bank notes in the bank note storage/supply box (8) or separating bank notes from the bank note storage/supply box (8), an upper and lower bank note support unit (809, 812) for rotating in a bank note stacking direction or in the counter-stacking direc-

tion to support the bank notes, holding the upper and lower portions of the bank notes, and setting them upright, and a holding plate (806), horizontally driven in the box with the bank notes held upright.

2. The bank note deposit/withdrawal machine of claim 1, wherein said upper and lower bank note support unit (809, 812) is driven in the same direction as the holding plate (806), and a bank note feeding speed is set to be higher than the moving speed of the holding plate (806).
3. The bank note deposit/withdrawal machine of claim 1, wherein said bank note storage/supply box (8) comprises a bank note guide which moves to a position at which bank notes can be led to the stack and separation mechanism when the bank notes are separated, and which is incorporated into the upper and lower bank note support unit (809, 812) at a top position when the bank notes are stacked.
4. The bank note deposit/withdrawal machine of claim 1, wherein said bank note storage/supply box (8) comprises a brush rolled (804) for feeding, by a radiantly extended flexible unit, the bank notes received from the stack and separation mechanism to a space in which the bank notes should be stored.
5. The bank note deposit/withdrawal machine of claim 4, wherein said bank note storage/supply box (8) comprises a bank note support unit (809) for supporting a lower end of the stored bank notes; and a bank note detection sensor (888), provided in a vicinity of an intersection between the enclosing brush roller (804) and an end of the bank note support unit (809), for detecting the existence/non-existence of the bank notes above the brush roller (804) for a predetermined time.
6. The bank note deposit/withdrawal machine of claim 5, wherein said holding plate (806) is moved toward the stack and separation mechanism when the bank note detection sensor of said bank note storage/supply box (8) detects residual bank notes continuously above the brush roller (804).
7. The bank note deposit/withdrawal machine of claim 1, wherein said bank note storage/supply box (8) comprises a detector for detecting the thickness or the tilt of the bank notes stacked upright and horizontally; and a controller for temporarily stops an operation of storing the bank notes in the bank note storage/supply box (8) when the detector detects a predetermined thickness or a predetermined tilt, and controlling the operation of storing the bank notes in the bank note storage/supply box (8) to be resumed after the holding plate (806) of the bank

note storage/supply box (8) has been driven in the counter-stacking direction.

8. The bank note deposit/withdrawal machine of claim 1, wherein said machine comprises a controller 5  
designed such that, when bank notes are transferred from a bank note storage/supply box (8) to another bank note storage/supply box (8), the amount of movement of the holding plate (806) of one bank note storage/supply box (8) is compared 10  
with the amount of the movement of the plate of the other bank note storage/supply box (8) so that the tilt of the bank notes stored in the other bank note storage/supply box (8) can be discriminated, and when the tilt is discriminated, the operation of storing 15  
the bank notes in the other bank note storage/supply box (8) is temporarily stopped, the holding plate (806) is driven in the counter-stacking direction to adjust the tilt of the bank notes, and then the storing operation is resumed. 20
9. The bank note deposit/withdrawal machine of claim 4, wherein said brush roller (804) includes a boss exposure portion on which radiantly arranged flexible units are not provided at a part. 25
10. The bank note deposit/withdrawal machine of claim 9, wherein said brush roller (804) can rotate in the bank note stacking direction when the bank notes are stacked in the storage space, and can stop at a predetermined position when the bank notes stored in the storage space are to be separated. 30
11. The bank note deposit/withdrawal machine of claim 9, wherein said bank note storage/supply box (8) comprises a stack deformation unit for forcibly deforming the stacked bank notes. 35
12. The bank note deposit/withdrawal machine of claim 9, wherein rotation of the brush roller (804) is controlled such that the predetermined positional relationship can be maintained between the front end of the stacked bank notes and the flexible units when the bank notes are stacked. 40  
45
13. The bank note deposit/withdrawal machine of claim 1, wherein said bank note storage/supply box (8) comprises a top plate for adjusting a position of a storage space depending on a size of bank notes to be stored. 50
14. The bank note deposit/withdrawal machine of claim 1, wherein said bank note storage/supply box (8) comprises side plates for adjusting a position of a storage space depending on a size of bank notes to be stored. 55
15. The bank note deposit/withdrawal machine of claim

1, wherein said bank note storage/supply box (8) comprises a flexible partitioning unit in a storage space in the vicinity of the storage/supply opening.

FIG. 1

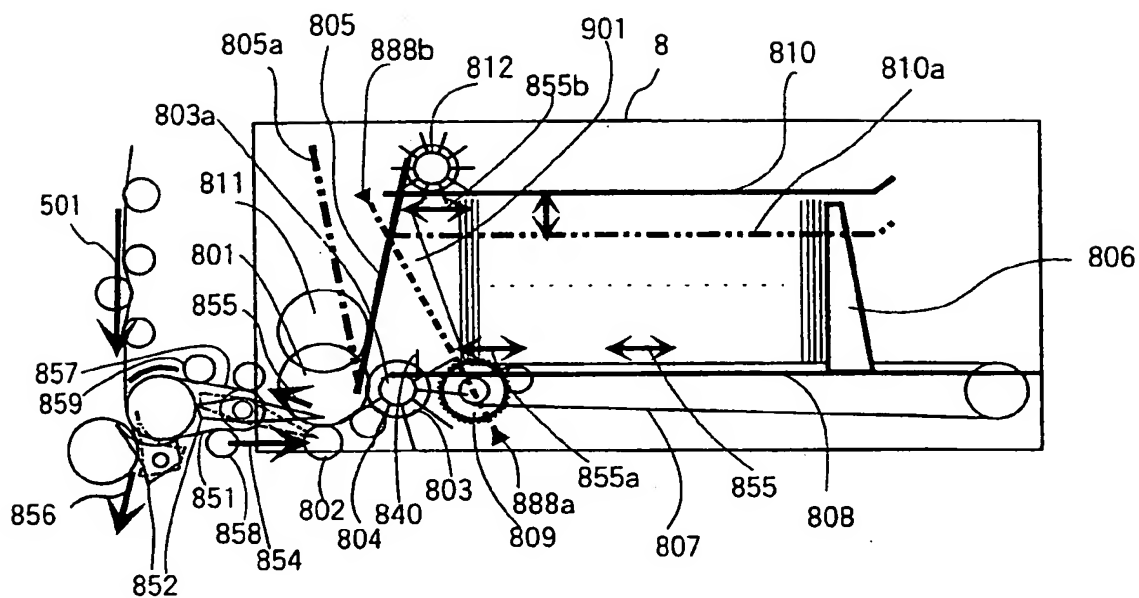


FIG. 2

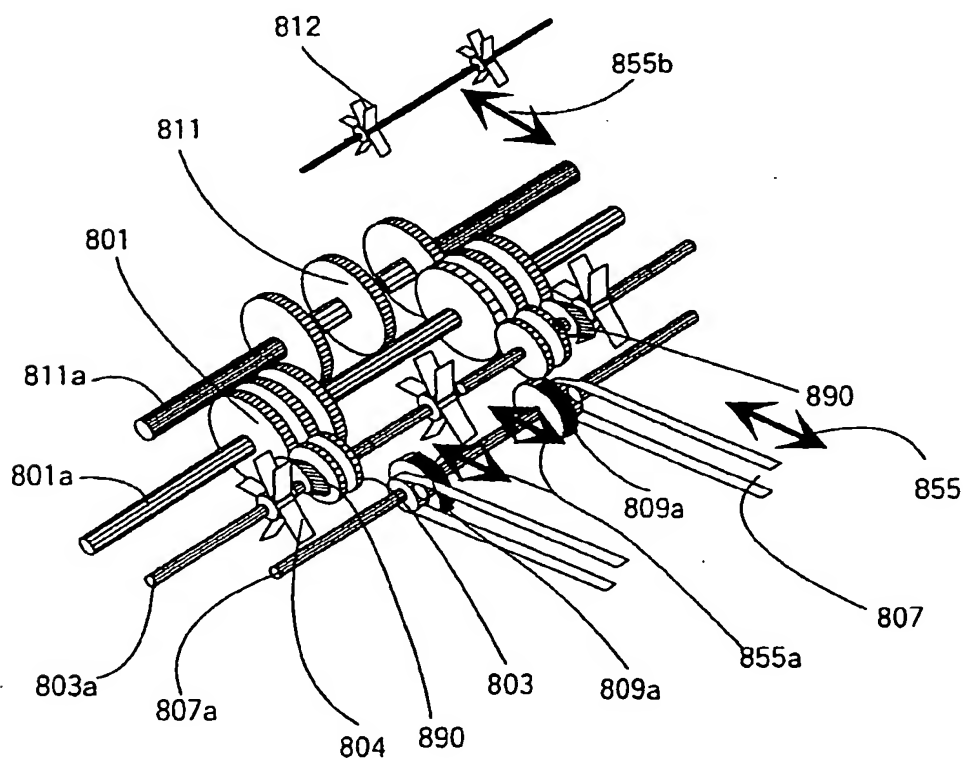


FIG. 3

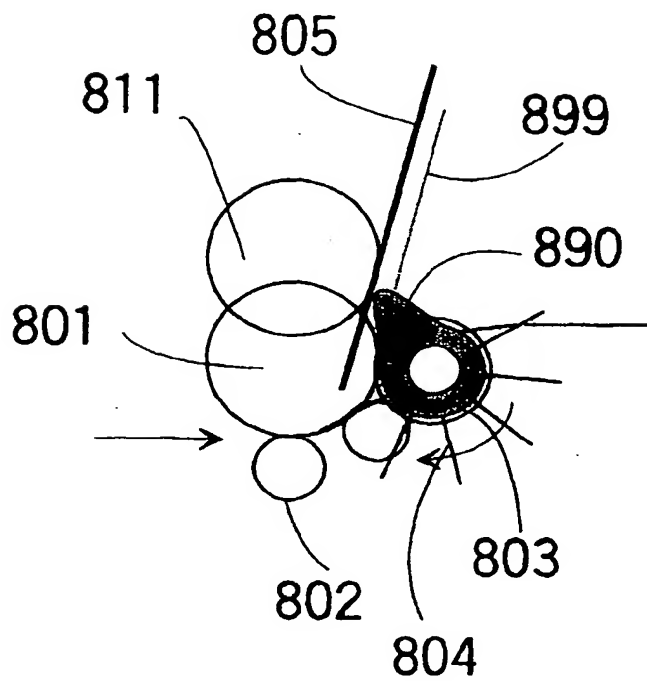


FIG. 4

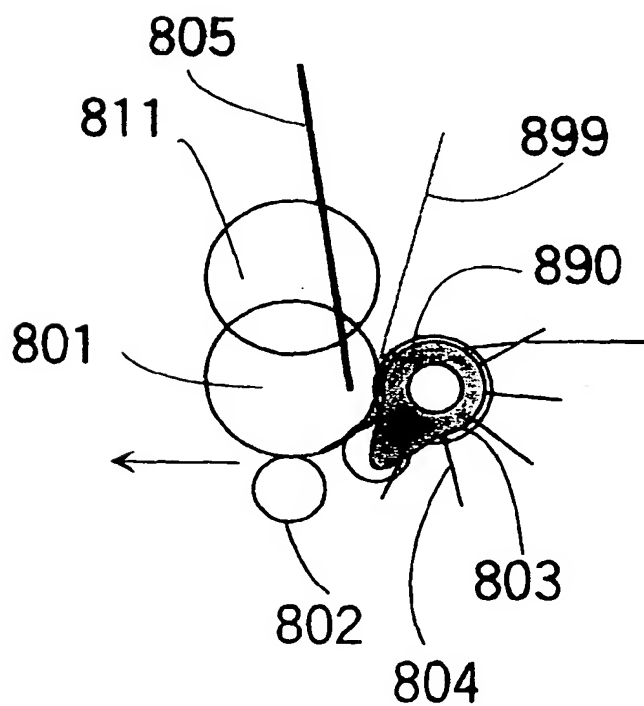


FIG. 5

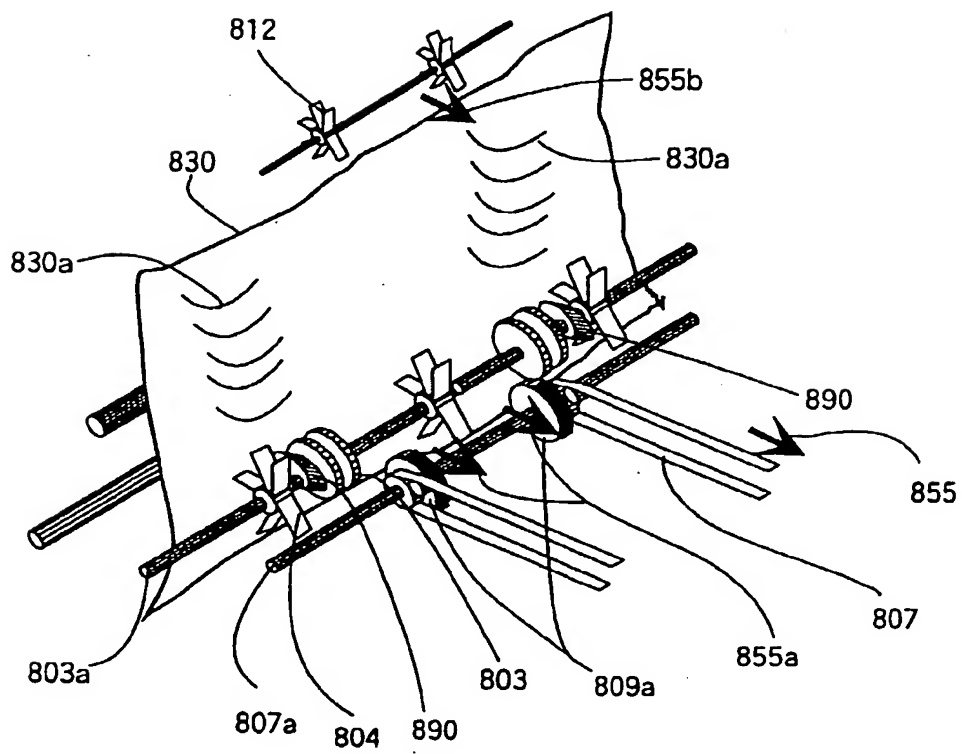


FIG. 6

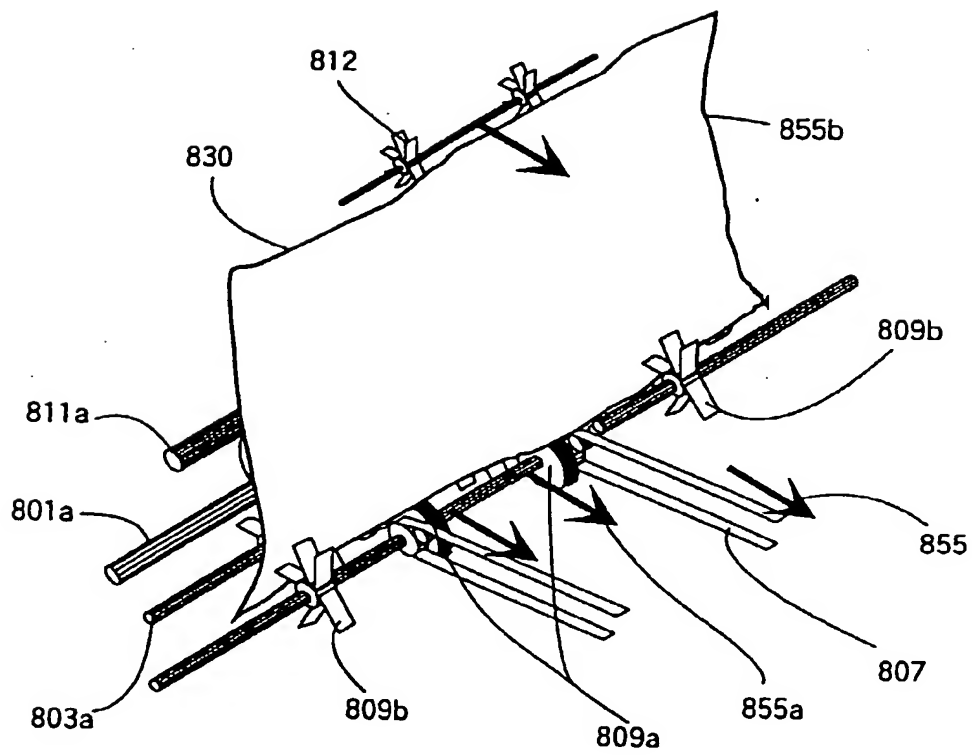


FIG. 7

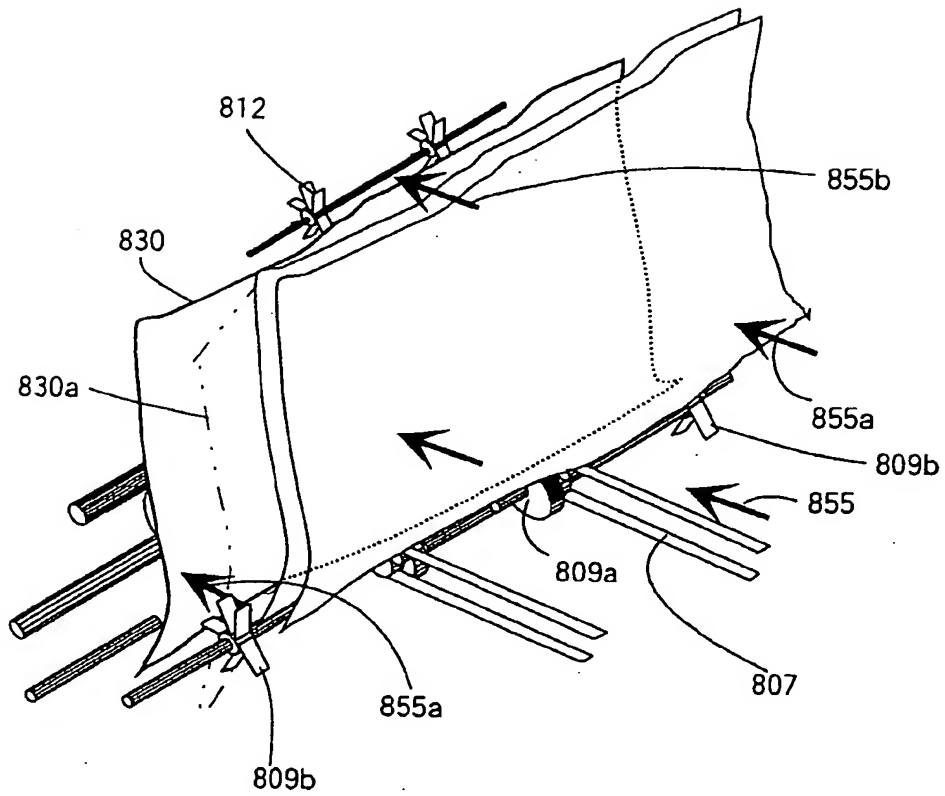


FIG. 8

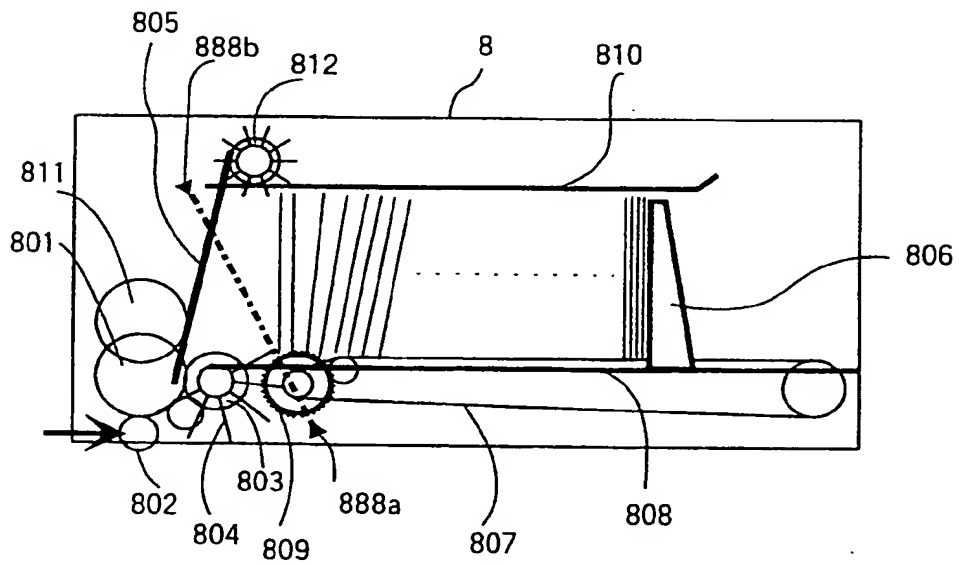




FIG. 9

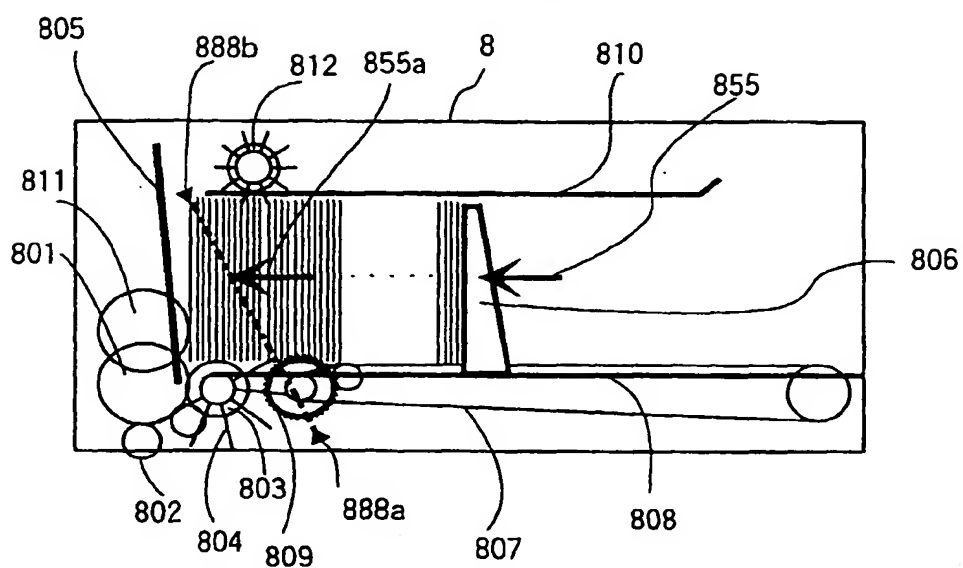


FIG. 10

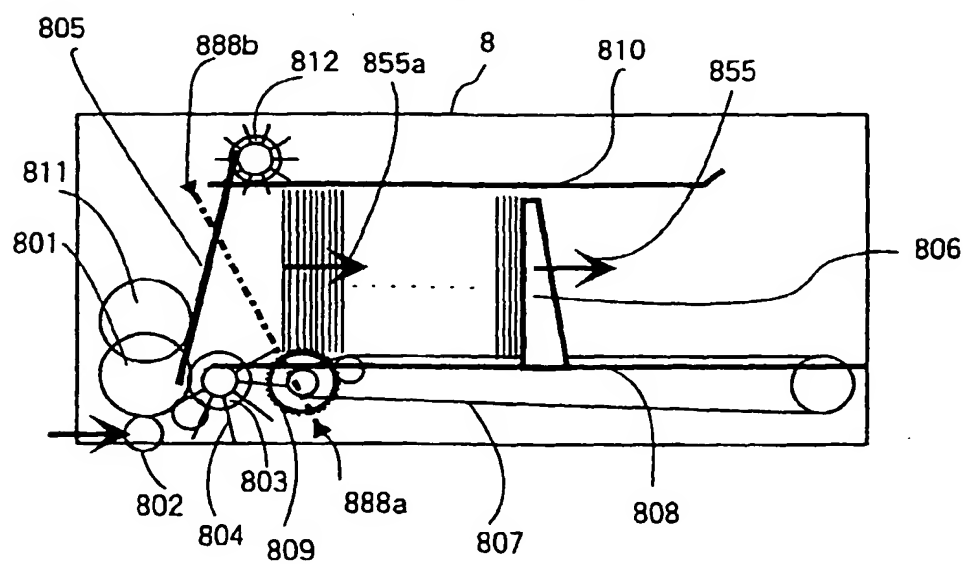


FIG. 11

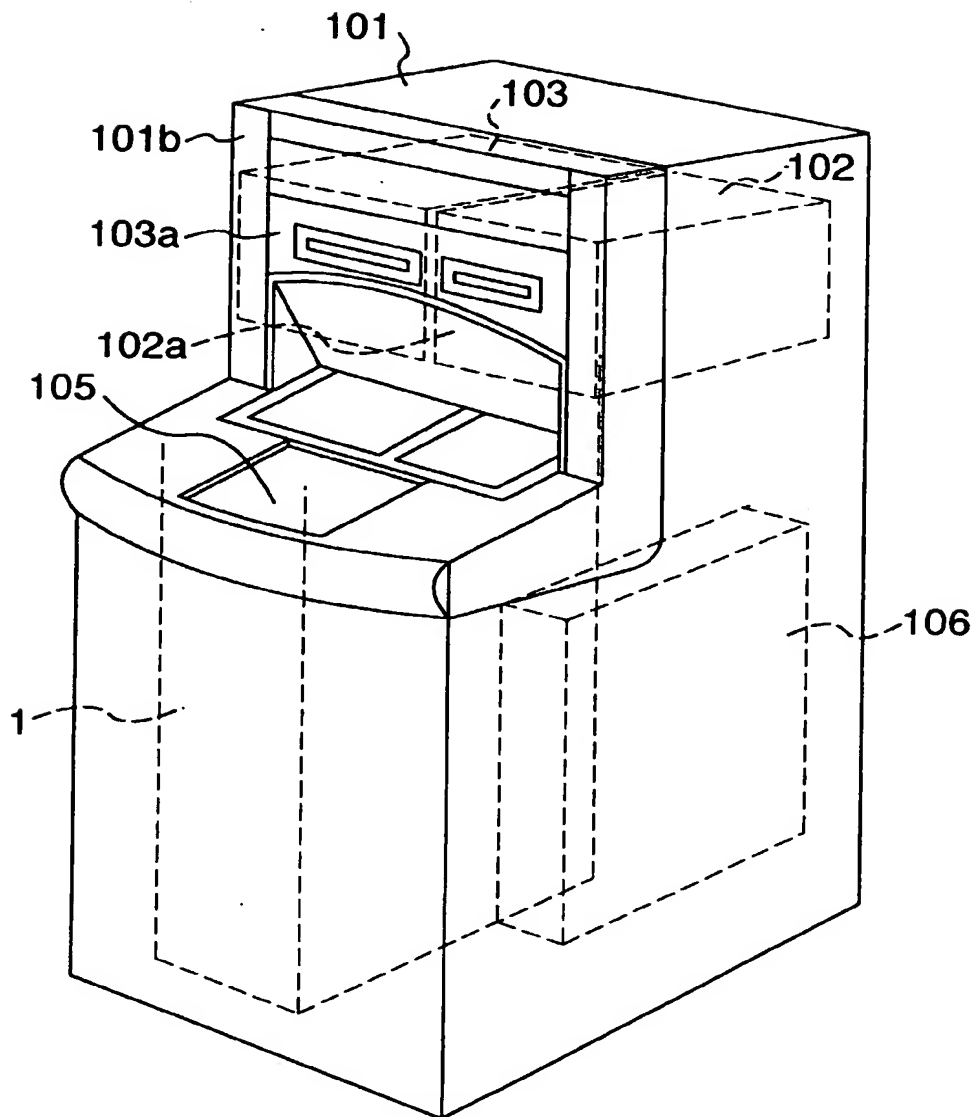


FIG. 12

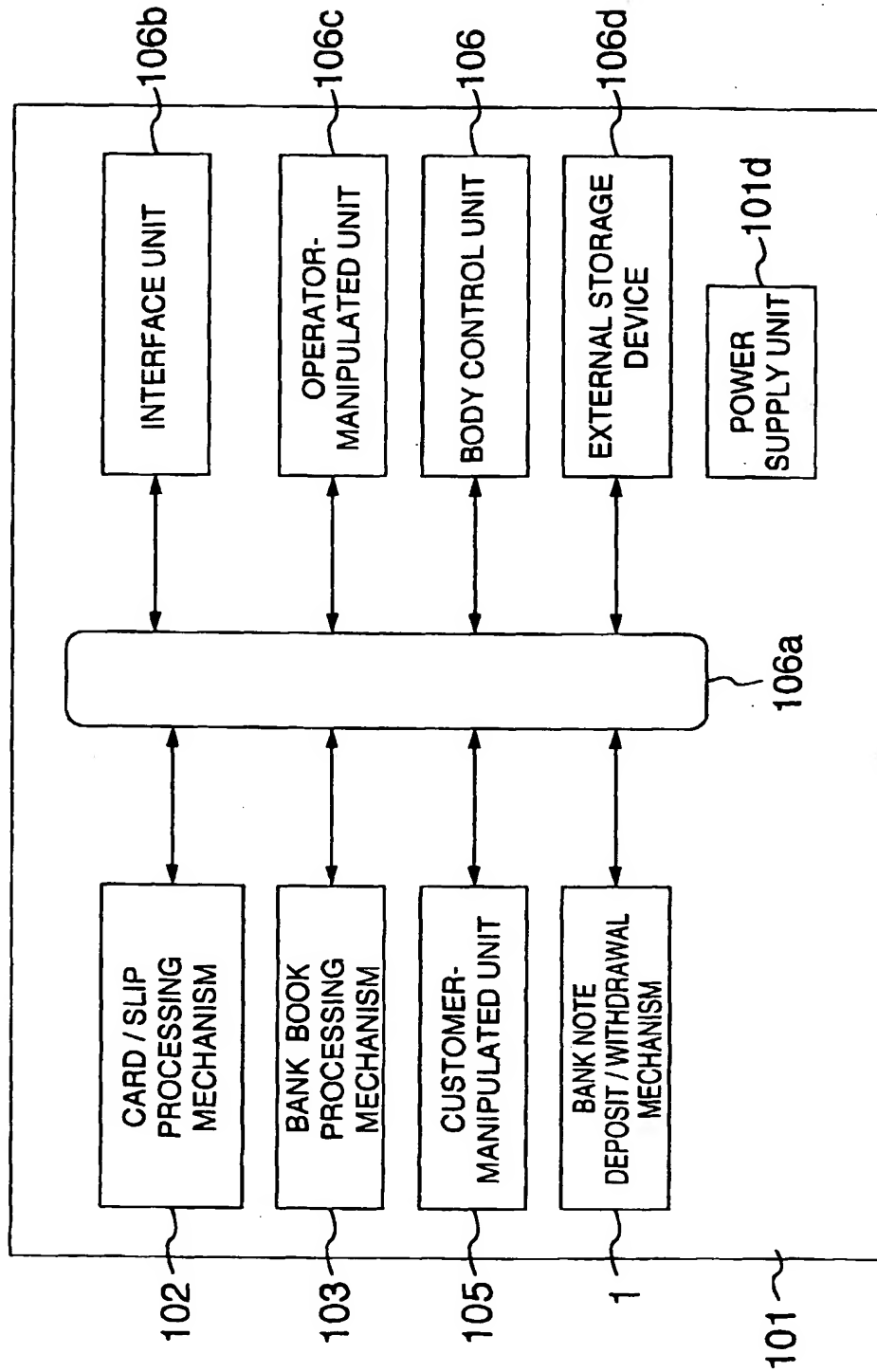


FIG. 13

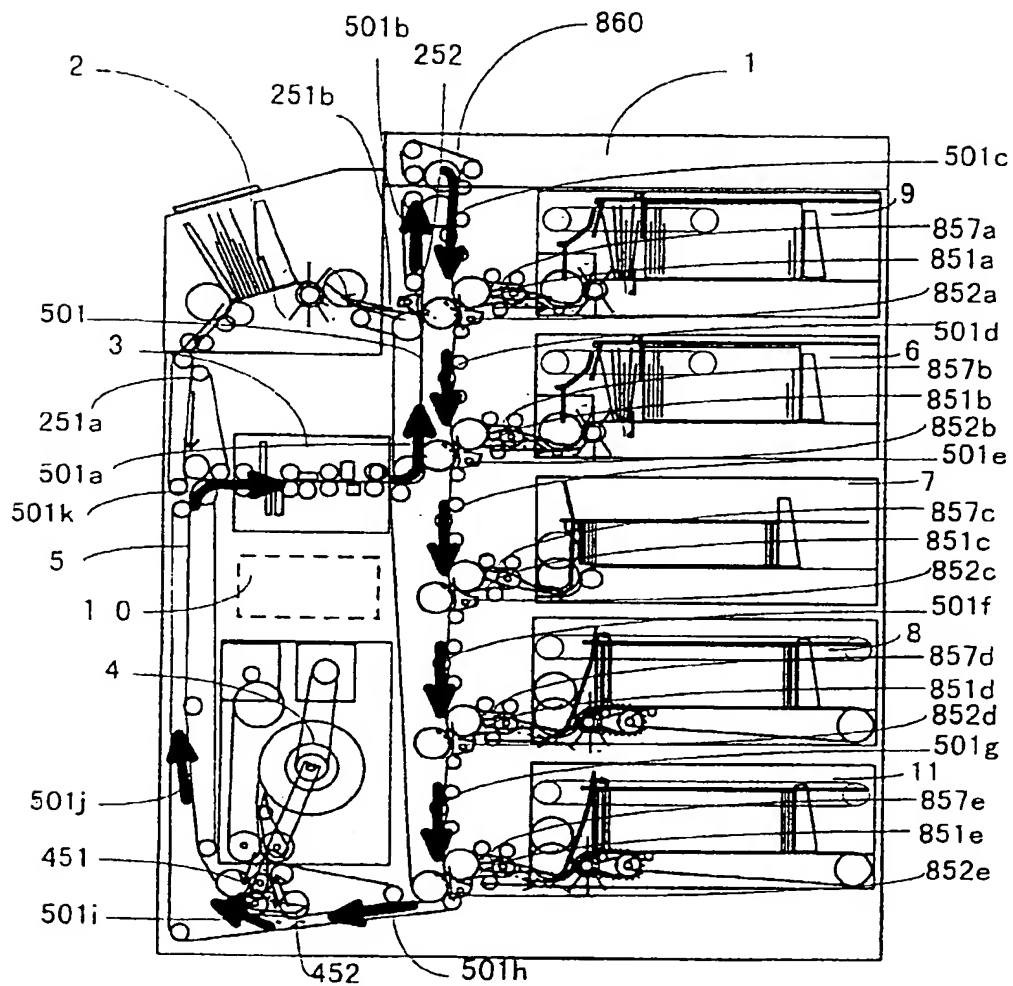


FIG. 14

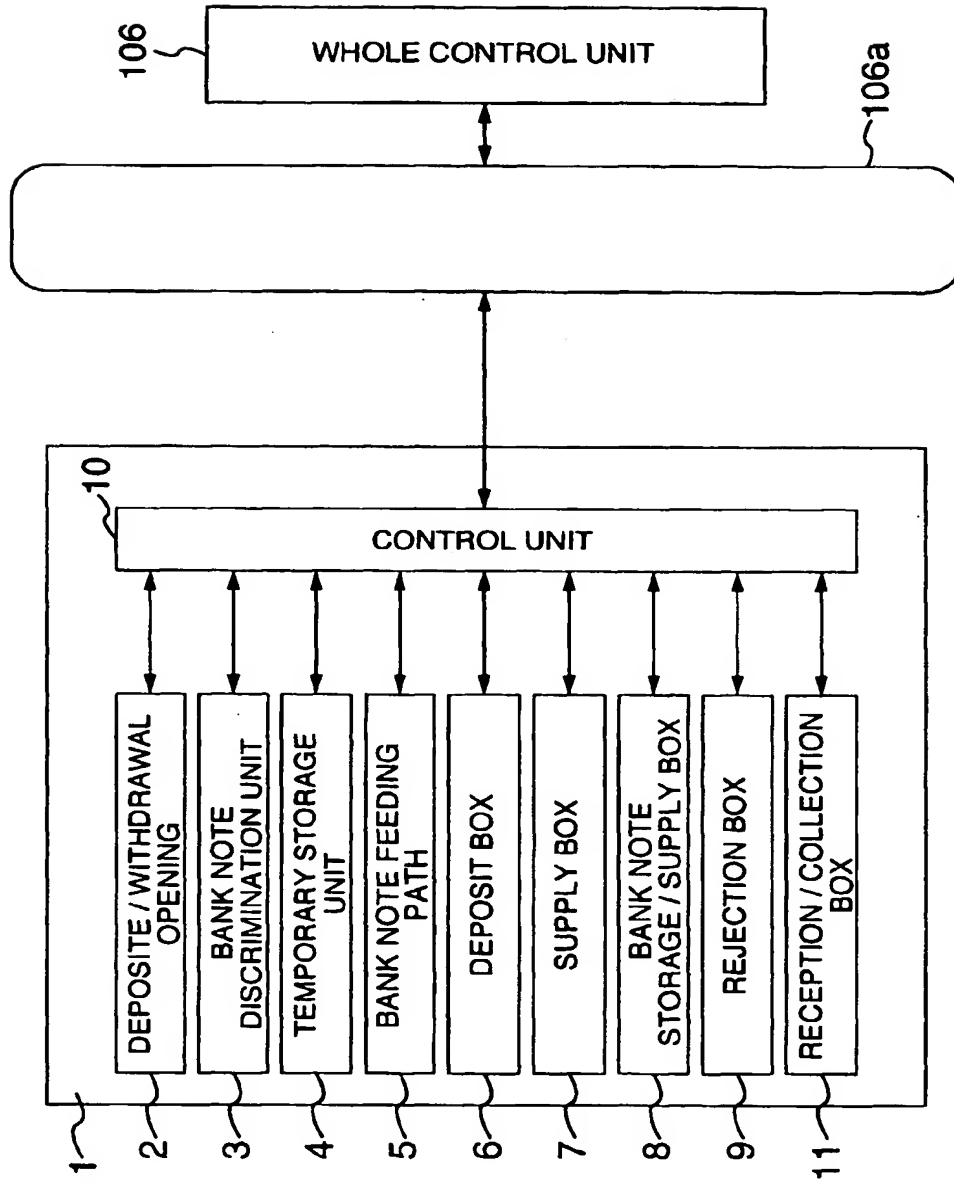


FIG. 15

